Chapter 5
Section 2
Energy
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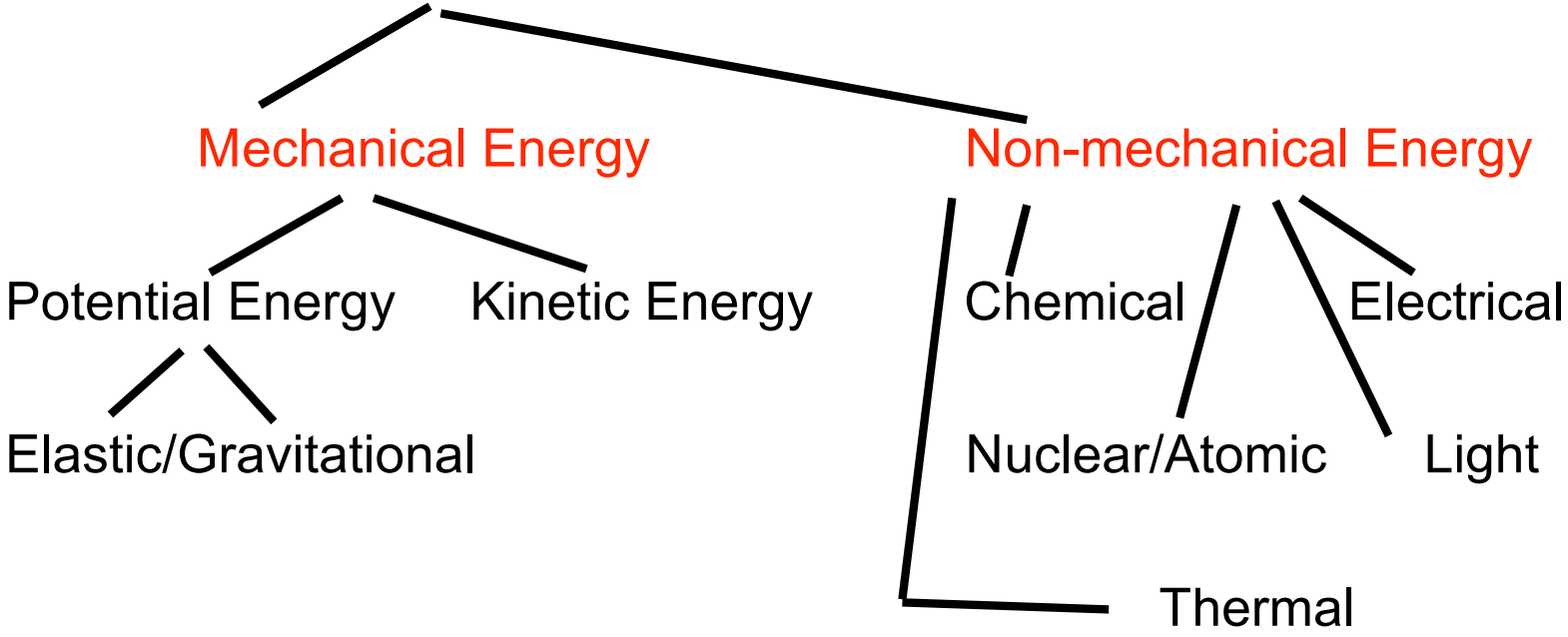
Energy

Energy: The ability to do work



Energy is measured in Joules just like work!

In this chapter we will be focusing on Mechanical Energy.

Why Energy Helps

Motion, in general, is hard to calculate.

Using forces, momentum, acceleration, etc. gets complicated because they are all vectors (have magnitude & direction).

Energy is not a vector; it's just a number.

Can predict motion by figuring out how much energy that motion will "cost."

Potential Energy (PE)

Potential energy is also called “stored energy” or energy of position.

Gravitational potential energy of an object is,

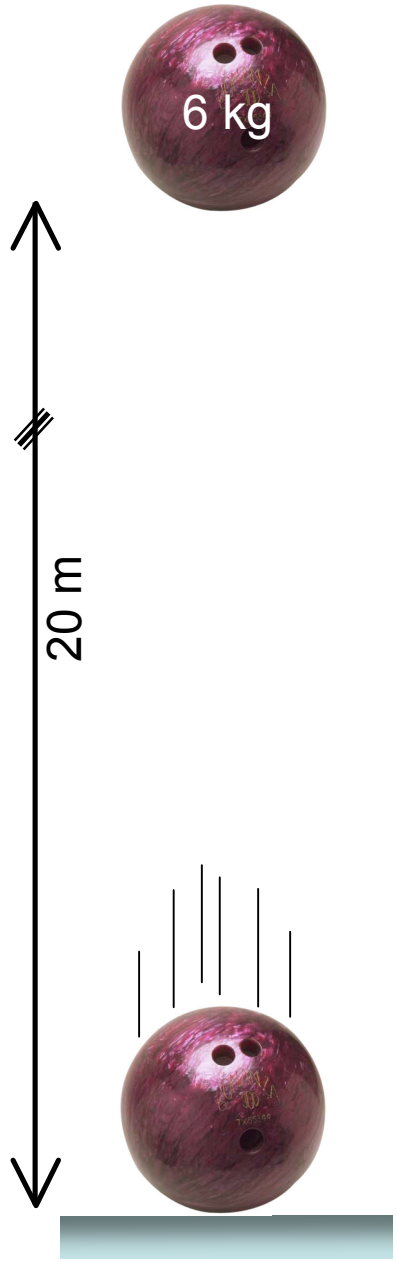
(Potential Energy) = (Weight) x (Height)

$$PE_g = mgh$$

Think of potential energy as stored energy or energy “in the bank.”

Metric unit of energy is Joules (same as for work).

Sample Problem



What is the potential energy of a 6kg bowling ball at a height of 20 meters?

Weight of the ball is

(Weight) = (Mass) x (Gravity Acceleration)

= (6 kg) x (9.8 m/s^2) = 59 N

Potential energy is

(Potential Energy) = (Weight) x (Height)

= (59 N) x (20 m)

= 1180 Joules

What is potential energy at zero height?

At a height of zero meters PE is zero Joules.

More Potential Energy

A stretched rubber band has the ability to do work. We call this type "elastic potential energy."

Elastic potential energy of an object is,

(Potential Energy) = 1/2 (spring constant) x (distance compressed or strectched) ^{2}

$$PE_{elastic} = 1/2\ k\ x^2$$

"k" is the spring constant. It's a number that tells how "stiff" the spring is. It's measured in N/m.

"x" is the distance the spring is compressed or stretched from its relaxed position. (meters)

Kinetic Energy (KE)

Kinetic energy of an object is,

$$(\text{Kinetic Energy}) = 1/2 \times (\text{Mass}) \times (\text{Speed})^2$$

$$KE = 1/2\ m\ v^2$$

Kinetic energy is the energy of <u>motion.</u>

A stationary object has zero kinetic energy.

A bowling ball and a volleyball are rolling at the same speed. Which has more KE?

The bowling ball, because it has more mass!

More Kinetic Energy

Q: What happens to the kinetic energy of an object if its mass were to suddenly double?

A: It doubles. Mass and KE are directly proportional.

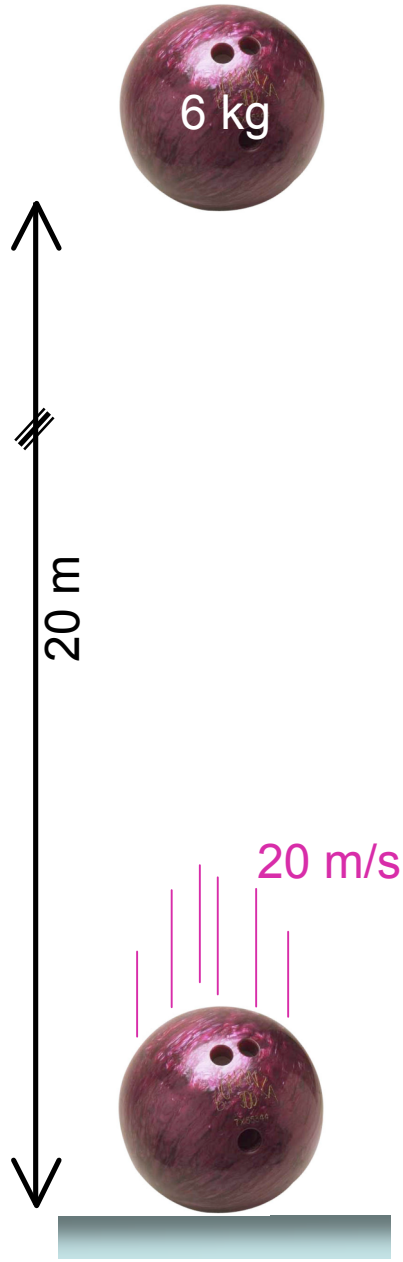
Q: What happens to the kinetic energy of an object if its velocity is doubled?

A: It quadruples. KE is directly proportional to the square of an object's velocity.

Q: What happens to the kinetic energy of an object if its velocity is tripled?

A: It becomes nine times greater!

Sample Problem



What is the kinetic energy of a 6kg bowling ball, falling from a height of 20 meters, just as it reaches the ground?

Takes 2 seconds to fall a distance of 20 meters.

Object's speed after falling 2 seconds is 19.8 m/s.

Kinetic energy is

(Kinetic Energy) = 1/2 (Mass) x (Speed) x (Speed)

= 1/2 (6 kg) x (19.8 m/s) ^{2}

= 1180 Joules

*Note. This is the same as its potential energy at its starting height from the previous example!